

Experiences of a Regulatory Agency with Safety Culture Assessment

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Three elements determine the safety performance of a company: the technical integrity of its installations, its safety management system, and its safety culture. The first requirement for good safety performance is that the technical installations are designed properly, inspected regularly and maintained well. This will assure their technical integrity. The way in which a company operates these installations is documented in the company's management system, and for safety this is the safety management system. More recently, it has become clear that attitude and behavior are also essential aspects for controlling major-accident risks, whereas the core values of a company and its way of communicating are important as well. Altogether, these constitute the third element of the model: safety culture. Big differences exist between companies, particularly regarding safety culture, which therefore justifies safety culture to be a separate element of the safety performance model. Moreover, a weak safety culture has been identified as a major contributor to industrial accidents.

DCMR Environmental Protection Agency acts as competent authority for environmental regulation in the Rotterdam-Rijnmond region, on behalf of the province of South-Holland and 15 municipalities. Key responsibilities include environmental licensing of high-risk companies and the associated supervision and enforcement. There are no legal requirements for having a good safety culture, but the importance of that third element for good safety performance stimulated the province of South-Holland to include safety culture assessment in its supervision policy and to require DCMR to make safety culture part of its supervision activities. The safety culture program of DCMR started in 2012 with an exploratory project by the Netherlands Organisation for Applied Scientific Research TNO. This turned out to be successful, and in 2013 DCMR carried out a pilot project in order to get a feeling about the feasibility of this addition and to develop an operational approach. Since 2014, safety culture assessment is formally included in the yearly work program. It is added as a separate activity to selected inspections, and carried out by safety experts since the findings cannot be translated into enforcement actions. Consequently, the primary objective is to stimulate these companies to introduce a safety culture program, or to continue it should they already have such a program in place, by "confronting" them with the findings of the assessment. In 2014 and 2015, safety culture assessments were carried out at 12 and 18 Seveso companies, respectively, with the addition of two non-Seveso companies in 2015, following the decision to expand the program to include that category. Most of these 32 companies were already paying attention to their safety culture or intending to do so, and also appeared to be amenable to suggestions for improving their safety culture.

1. Introduction

The Rotterdam-Rijnmond region is not only the most densely populated area in the Netherlands, with more than 1 million people living within an area of less than 800 km², it is also heavily industrialized. Many chemical and petrochemical plants, power plants, and storage and transshipment companies are located in this area. Among these there are a substantial number of Seveso sites, some 100, and many other companies that deal with hazardous materials, making safety an important issue in the Rotterdam-Rijnmond region. On behalf of the province of South-Holland and 15 municipalities, DCMR Environmental Protection Agency acts as competent authority for environmental regulation in this region. Key responsibilities include environmental licensing of high-risk companies and the associated supervision and enforcement.

In 2012, Odfjell Terminals Rotterdam, a large storage company in the Rotterdam-Rijnmond region, decided to temporarily shut down its facilities after a period of increasing pressure by the supervisory authorities. Reason for this was a long-lasting poor safety situation and a bad safety culture, although the company had a certified environmental management system. This incident and similar events at companies in other parts of the country led to increased attention for supervision and enforcement at high-risk companies. The province of South-Holland tightened its associated policy, and DCMR initiated a program to improve the operational activities which are related with that policy. Explicit attention for safety culture, one of the elements of good safety performance, would be part of this program – a decision which was strongly supported by recommendations of the Dutch Safety Board in their report on the safety situation at Odfjell between 2000 and 2012 (Dutch Safety Board, 2013). DCMR's experiences with safety culture assessment are the key focus of this paper. It starts with summarizing the three elements which determine the safety performance of a company (section 2). The Hearts and Minds approach, a commonly used method to assess safety culture, is briefly introduced in section 3. Next, sections 4 and 5 describe the safety culture program of DCMR. Concluding remarks are given in section 6.

2. Safety focus and safety performance

Over time, different perspectives have been the focus of the industrial safety community (Figure 2). The technical integrity of installations was the primary issue of interest in the 60s, 70s and 80s of the previous century. An additional focus on human error and management systems emerged in the 80s and continued in the 90s. A prominent example of this is the second European Union Seveso Directive of 1996, which contained specified requirements for the safety management system of companies that have to comply with this directive. More recently, in the current century, safety culture emerged as a third issue of interest (sometimes referred to as the third wave).

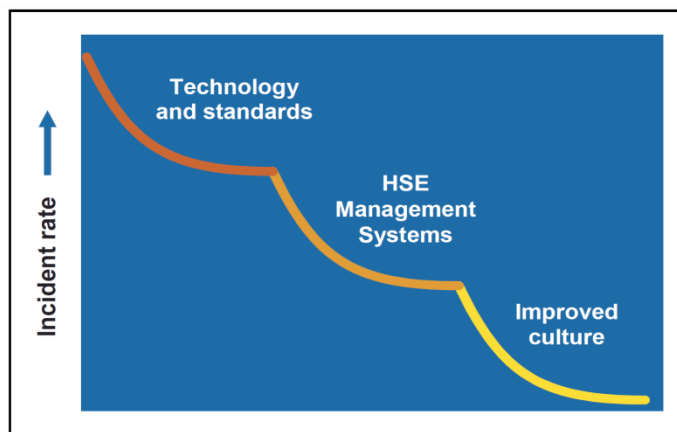


Figure 1: Development of safety focus over time

All three elements mentioned above determine the safety performance of a company: the technical integrity of its installations, its safety management system, and its safety culture (Figure 2). The first requirement for good safety performance is that the technical installations are designed properly, inspected regularly and maintained well. This will assure their technical integrity. The way in which a company operates these installations is documented in the company's management system, and for safety this is the safety management system. A key part of the safety management system is the structured identification and evaluation of risks and the subsequent definition of control measures. More recently, it has become clear that attitude and behaviour are also essential aspects for controlling major-accident risks, whereas the core values of a company and its way of communicating are important as well. Altogether, these constitute the third element of the model: safety culture. Big differences exist between companies, particularly regarding safety culture, which therefore justifies safety culture to be a separate element of the safety performance model. Moreover, a weak safety culture has been identified as a major contributor to industrial accidents. A company which succeeds in achieving a high score for each of the three elements will be able to show excellent safety performance.



Figure 2: Safety performance model

3. Safety culture: the Hearts and Minds approach

The Hearts and Minds methodology is one of the approaches for assessing safety culture and common in the chemical and process industries. It was originally developed for Shell International Exploration and Production BV, but made available to industry. Hearts and Minds consists of 18 elements (Parker et al., 2006). Examples are leadership and commitment, size and status of HSE department, work-site job safety techniques, contractor management, and communication. Five levels of safety culture are distinguished which are visualized through the safety culture ladder (Figure 3), and questionnaires are used in order to assess the safety culture level for all elements. An important aspect of applying the Hearts and Minds methodology is that it should lead to defining improvement actions for weak elements (something which is not always done).



Figure 3: Hearts and Minds safety culture ladder

4. Safety culture program of DCMR (1): Exploratory project

DCMR Environmental Protection Agency started its safety culture program in 2012. As a first step, the Netherlands Organisation for Applied Scientific Research TNO was commissioned to examine safety culture quality at 14 companies, divided over four industrial sectors: refineries, chemical industry, tank terminals, and

storage and transshipment companies. Objectives of the project were to gain insight in the safety culture at these 14 companies and also to enable benchmarking between sectors and between companies within a sector.

The project was carried out through performing a quick scan, developed by TNO to measure a company's safety culture. This quick scan distinguishes 14 safety culture dimensions, nine of which are taken from the Hearts and Minds methodology. These nine dimensions are the ones that have the strongest relation with process safety. The other five dimensions are added because they are considered to be relevant for process safety but are not part of the Hearts and Minds methodology. Examples of the latter are learning from incidents and maintenance management.

Each safety culture measurement took two days and was carried out by two TNO researchers. Various sources of information were used, the most important one being interviews with employees at all levels of the company. The resulting information was assessed independently by the two researchers before making up a final score. A scale of 1 to 5 was used, related to the five levels of the safety culture ladder, with 1 being pathological and 5 being generative. The most important results were the following:

- The scores of the 14 companies varied from reactive/calculative to proactive.
- Nine companies did have a good safety culture, whereas three companies did have a couple of weak safety culture dimensions. Safety culture was insufficiently developed at the remaining two companies.
- Average culture scores per company were 3.7 for refineries, 3.9 for chemical companies, 3.3 for tank terminals, and 2.8 for storage and transshipment companies. The highest score was 4.0, with 2.5 being the lowest one.
- There is room for meaningfully improving the safety culture at all companies.

The results show the strengths and weaknesses of the safety culture for the individual companies, so that each company could use these for further improvement. It was concluded that it turned out to be possible to differentiate between companies with a good safety culture and companies with a weak safety culture, and also to differentiate between the four industrial sectors. The TNO study is described in more detail by Zwetsloot et al. (2015).

A number of follow-up activities were defined:

- For the two companies with a below-average score, it was decided to increase the intensity of supervision.
- DCMR will incorporate safety culture as a topic within selected Seveso inspections. As a first step, a pilot project will be carried out.
- DCMR will organize regional workshops in which the results of the TNO study are presented and discussed, and will also discuss with regional as well as national industry associations how companies can be stimulated to adopt a structured approach to improve their safety culture.

5. Safety culture program of DCMR (2)

In 2013, DCMR defined a pilot project on how to address safety culture within Seveso inspections. Safety culture was added as a specific topic to inspections at three Seveso companies and assessed by a safety expert. During the close-out meeting, the company was stimulated to go on with safety culture. In general, experiences were positive: the companies showed interest in the subject and appreciated DCMR's initiative to address it. Thus, safety culture was formally included in the 2014 work program. This was continued in 2015, in which also a number of assessments were to be carried out at a number of non-Seveso companies.

The safety culture program of DCMR consists of three elements: selection of companies, safety culture assessment, and communication with industry associations.

5.1 Selection of companies

All Seveso inspectors of the various regulatory agencies in the Netherlands have provided scores for a number of aspects of "their" companies, including for safety culture. They have received training in the Hearts and Minds methodology, thus being able to recognize a weak safety culture. The result of this exercise was a national ranking of Seveso companies. An inspection was not part of the process – the inspectors' scores were based on their general knowledge of the companies. DCMR used this ranking as one of the ingredients for selecting companies, together with its internal risk-based ranking and the safety management system scores of its Seveso companies. For 2015, more importance was given to the national ranking, since its quality is increasing over time. In total, 12 companies were selected for the 2014 safety culture program and 18 companies for the 2015 program. These companies were characterized by a low score on safety culture and were considered to be amenable to suggestions for improving their safety culture.

Selection of additional non-Seveso companies for the 2015 program was based on DCMR's internal data and experiences. Five companies were selected, but only two assessments were carried out. Three companies refused to cooperate because of the absence of legal requirements on safety culture.

5.2 Safety culture assessment: approach

Safety culture assessment is carried out as add-on to the regular inspection – during the inspection, but as a separate activity. The assessments are done by a safety expert, not by the inspectors. The latter have general knowledge about safety culture, as opposed to more detailed expertise. Also, the inspectors are particularly focused on enforcement, whereas the focus of assessing safety culture is on stimulating it. A key characteristic of the approach is that it is concerned with an assessment of the company's safety culture, not with a measurement.

The approach consists of five steps:

- Results of earlier inspections are studied in order to select those safety management system elements that are possibly affected by the company's safety culture.
- Interviews are carried out at all levels of the company: senior management, which is interviewed first (top-down approach) – HSE personnel – shift supervisor – operator. Objectives of this are to check consistency and also to find out whether there exists a clay layer in the company: does the message reach the shop floor?
- An assessment is made of the company's safety culture.
- The results of the assessment are communicated with company representatives – the company is challenged to take up those issues that require improvement. Purpose of this is to stimulate the company to initiate a safety culture program or to intensify an already existing program.
- The results of the assessment are communicated with the inspector in order to point out those safety management system elements that require priority during the next inspection.

The focus in the interviews is on four essential dimensions of safety culture that experience has shown to be most important:

- Leadership and management commitment.
- Involvement and empowerment of the employees.
- Communication.
- The learning ability of the organization.

Specific questions have been defined for each of these four elements. Aspects of "leadership and management commitment" are: What is the ambition of senior management regarding safety culture? How is senior management going to realize that ambition? Is there an open culture?

Aspects of "involvement and empowerment of the employees" include: Are the operators trained in safety issues? Are the operators involved in the improvement plans of the company and do they have the opportunity to make improvement suggestions? Are the operators allowed to stop production in case of an emergency, and has this occurred? Are the employees proud of their job?

The dimension "communication" is assessed through such questions as: How is communication about safety matters carried out? Is safety just a slogan or do promotion campaigns exist? Is there a safety improvement plan and if so, is everyone aware of it? Are improvement actions communicated with all employees?

And finally, aspects of "the learning ability of the organization" are: Is a safety culture improvement plan available? Are all improvement actions implemented? Is safety culture improvement evaluated?

5.3 Safety culture assessment: findings

Three score levels are distinguished for the eventual assessment of the company's safety culture: green, orange and red. A company which has started a safety culture improvement program and has carried out an evaluation receives score level "green". A baseline measurement has been done, and there are training programs for employees at all levels of the company. Also, a second measurement will take place, including the associated follow-up. Feedback to a company with a "green" score level includes that it is complimented on its safety culture program and is stimulated to continue this.

In order to receive score level "orange", the company must have started investigating its safety culture and must have initiated a safety culture program. It has not been implemented at all layers of the company, however, and there are no completed improvement plans. Feedback to a company with an "orange" score level is that it is stimulated to continue improving its safety culture.

When a company has not made an assessment of its safety culture or does not have a safety culture program, it receives score level "red". There is no intention to start a safety culture program, the company is satisfied with the current situation, and it has a weak safety management system. Feedback to a company with a "red" score level focuses on stimulating it to start a safety culture improvement plan.

In the course of 2015, it was decided to define a fourth category, with score level "yellow", in order to indicate a company which has not yet started a safety culture program but is about to start it or willing to do so, thus distinguishing it from a company with score level "red" that has no intention at all to start a program.

Of the 12 companies which were visited in 2014, 2 received score level “green”, 7 score level “orange”, and 3 score level “red”. The 2015 program showed a similar picture: of the 20 companies which were visited, 3 received score level “green”, 10 score level “orange” (one of which was a non-Seveso company), 5 score level “yellow” (one of which was a non-Seveso company), and 2 score level “red”.

5.4 Communication with industry associations

Regional as well as national industry associations have been approached in order to achieve their cooperation in stimulating safety culture at their member companies. The national associations are somewhat reserved about government initiatives on safety culture – in their view, safety culture assessment cannot be part of inspections since there is no legislation on this. Nevertheless, they are interested in the results of the assessments which DCMR carries out and are willing to discuss these. Several exchanges of information have taken place already.

Cooperation with Deltalinqs, the regional industry association, turns out to be more successful. Two meetings for storage and transshipment companies have been organized jointly, and future meetings are being considered.

6. In conclusion

Good safety performance requires high scores for three elements: the technical integrity of installations, the safety management system, and safety culture. In contrast with technical integrity and the safety management system, there are no legal requirements for having a good safety culture, and there exists no standard for it, so any activity has to occur on a voluntary basis. After an exploratory project by TNO in 2012 and a pilot project of its own in 2013, DCMR Environmental Protection Agency decided to include safety culture as a topic in its Seveso inspections. In 2014 and 2015, safety culture assessments were carried out at 12 and 18 Seveso companies, respectively, with the addition of two non-Seveso companies in 2015, following the decision to expand the program to include that category. The findings demonstrate that most companies are paying attention to their safety culture and appear to be amenable to suggestions for improving it. Three of the 12 companies in 2014 and two of the 18 in 2015, however, indicated that they did not appreciate the added value of initiating a safety culture improvement program, whereas three of the five non-Seveso companies that were selected for the 2015 program even refused to cooperate because of the absence of legal requirements on safety culture. Although it is not expected that there will be legislation with respect to safety culture in the future, having a bad safety culture could play a role in legal procedures after an accident.

Communication with industry organizations is also part of DCMR's safety culture assessment program. Experiences there are mixed: the national industry associations are somewhat reserved about government initiatives on safety culture, whereas Deltalinqs, the regional industry association, tends to be more cooperative and is interested in organizing joint meetings.

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